MULTIMETRICS, INC.

SERIES AF-200 VARIABLE ACTIVE FILTER

INSTRUCTION MANUAL

Model AF- ~~220~~ S/N ~~810023~~

Unit wired for 115 [X] 230 [ ] operation

ADDENDUM AF-200 SERIES

1. Measurement of Cutoff Frequency Accuracy

Set CUTOFF FREQ Hz dial to desired Fco. Vary frequency of input signal until -3db point is reached at AF-200 output. The signal generator indicated frequency must fall within ± 5% of AF-200 CUTOFF FREQ Hz dial reading. Frequency calibration accuracy and amplitude flatness of signal generator and detector must be taken into consideration for this measurement. (See page 2 of manual).

2. Electrical Parts List Changes

a. R117, R118 changed to Resistor, Composition
1000 ohms, ± 10%, 1/2 watt.

b. R238 changed to Resistor, Composition
1500 ohms, ± 10%, 1/2 watt.

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WARRANTY

Multimetrics instruments are warranted against defective materials or workmanship for one year from date of delivery. We will repair, within this period, such instruments or their components (except batteries) which under normal use, and in our sole opinion, prove to be defective when returned to our factory. No other warranty is expressed or implied. Transportation to our factory is to be prepaid by the purchaser. Returned instruments will not be accepted unless prior authorization has been given by a representative of Multimetrics, Inc. We are not responsible for consequential damages.

This warranty does not apply to any of our products which have been altered or repaired by persons not authorized by us, or in accordance with instructions furnished by us. Nor does it apply to any product of ours which has been used in a hazardous or dangerous manner either alone or in conjunction with other equipment. If the instrument is defective as a result of improper repair, misuse, or abnormal conditions or operations, repairs will be billed at cost.

1. INTRODUCTION

ELECTRICAL:

The Multimetrics Series AF-200 single and dual channel active filters achieve an exceptionally high level of parameter stability and uniformity through computer-aided circuit design and analysis.

Utilizing conservatively derated silicon semiconductors throughout, this addition to the Multimetrics product line meets the requirements for high reliability and versatility in variable active filter applications.

Individual channels are operable as either low pass or high pass filters with their cutoff frequencies continuously adjustable from 0.2 Hz to 20 kHz. Connecting two channels in series, with one channel operating in its low pass mode, and the second in its high pass mode, results in a band pass filter, with continuously adjustable bandwidth. Connecting two channels in parallel, with one operating in its low pass mode, and the second in its high pass mode, results in a band reject filter with a continuously adjustable rejection band.

Response in the low pass mode is to zero frequency by virtue of DC coupling; in the high pass mode, response is essentially flat to 200 kHz, rolling off to -3db at approximately 1 MHz. Attenuation slope is 24db/octave in stop bands; when individual channels are series-connected in identical modes and cutoff frequencies, attenuation slope is 48db/octave.

Each channel consists of four R/C networks (decade-determining capacitors and variable resistances for continuous tuning within each frequency decade) and associated input, output and feedback amplifiers that provide necessary gain, isolation and impedance levels. The resulting circuit configuration yields attenuation slopes that closely follow classical 4-pole Butterworth performance.

A rear panel switch changes the performance characteristics of its filter channel in the low pass mode from maximally flat amplitude to time domain response(T/D) for those circuit applications requiring optimum transient behavior.

Another rear panel switch is provided which isolates signal ground from chassis for applications requiring floating operation.

MECHANICAL

The Series AF-200 filters are packaged consistent with the ever-changing needs of the busy electronics laboratory. A convenient bail bar permits raising the front end of the instrument for easier visibility of the controls when it is operated on a bench. Rack adapters are available for incorporation in system racks.

2. SPECIFICATIONS

FUNCTIONS

SINGLE CHANNEL		DUAL CHANNEL					
		EACH CHANNEL		SERIES CONNECTED		PARALLEL CONNECTED	
MODE	SLOPE db/Octave	MODE	SLOPE db/Octave	MODE	SLOPE db/Octave	MODE	SLOPE db/Octave
High Pass Low Pass	24 24	High Pass Low Pass	24 24	High Pass Low Pass Band Pass	48 48 24	Band- Reject	24

CUT-OFF FREQUENCY RANGES

MULTIPLIER	FREQUENCY (Hz)
.1	.2 to 2
1	2 to 20
10	20 to 200
100	200 to 2K
1K	2K to 20K

CUT-OFF FREQUENCY ACCURACY ± 5% in maximally flat mode to 20 kHz

PASS-BAND GAIN Unity ± 0.5db DC to 200 kHz; 3db at approximately 1 MHz -6db in band reject mode.

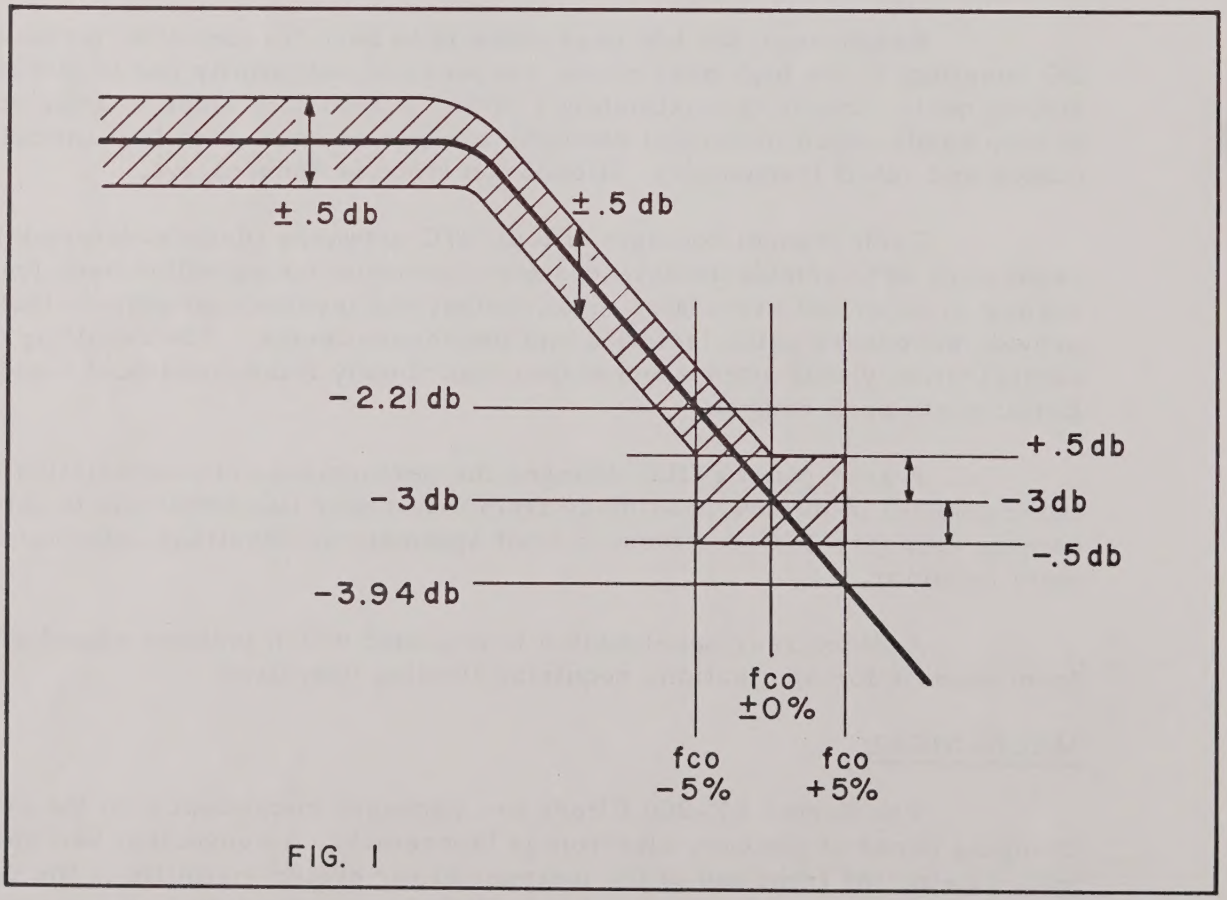


FIG. 1

With a cutoff frequency tolerance of ±5%, gain errors of approximately +0.8db and -0.9db, as shown in figure 1, are possible. Multimetrics' specification for this gain error is held to ±0.5db, as is the remainder of the pass-band.

ATTENUATION: 80 db or greater

INPUT: Impedance-1 megohm in parallel with 50 pf
Max. AC-3V rms to 1 MHz
Max. AC & DC-4.2v peak(low pass), 100V peak(high pass)

OUTPUT: Impedance-50 ohms, nominal
Voltage-3V rms to 200 kHz; 2V rms at 1 MHz
Current-50 ma, maximum
DC Level Drift-0.25 millivolts/hour at constant ambient temperature
Ripple and Noise-100 microvolts rms max. for 1 MHz bandwidth, measured with input shorted and GROUND switch in CHASSIS position
Temperature Coefficient-±2 mV/°C, typical

CONTROLS: Front Panel- Cutoff frequency dial, multiplier-function switch, DC balance (screwdriver)-1 per channel; power switch
Rear Panel- Flat or T/D response switch, ground/floating switch-1 per channel

TERMINALS: Front Panel- 1 BNC female input per channel
1 BNC female output per channel
Rear Panel- Input and output same as front panel; chassis ground binding post; fuse post

OPERATING TEMPERATURE RANGE: 0° to 50°C

POWER REQUIREMENTS: 100-130/200-260V, single phase, 47 to 440Hz
AF-210, 1.5 watts
AF-220, 3.0 watts

DIMENSIONS AND WEIGHTS:

Model	Channels	Style	H.	W.	D.	Net Wt.	Ship Wt.
AF-210	1	Bench	4 3/4"	8 3/8"	15 1/2"	7 1/2 lbs.	12 lbs.
AF-220	2	Bench	4 3/4"	8 3/8"	15 1/2"	12 lbs.	17 lbs.
AFR-1	1	Rack Adapter	5 1/4"	19"	--	2 lbs.	4 lbs.
AFR-2	2	Rack Adapter	5 1/4"	19"	--	1 1/2 lbs.	4 lbs.

FINISH: Front Panel- Brushed Aluminum
Rear Panel & Internal Structure- Alodined aluminum
Cover- Blue, painted steel

3. LINE VOLTAGE AND FUSES

Series AF-200 filters are designed to operate from a single phase power source with a frequency range of 47 to 440Hz. Units for use in the United States and Canada are wired for 100-130 volts(see figure 2A) and units for use elsewhere are wired for 200-260 volts(see figure 2B). Conversion from one line voltage setting to the other is accomplished by connecting the jumpers as shown in figure 2 for the desired setting. Fuse requirements are as shown:

Model	100-130V	200-260V
AF-210	1/8 amp slo-blow	1/16 amp slo-blow
AF-220	1/4 amp slo-blow	1/8 amp slow-blow

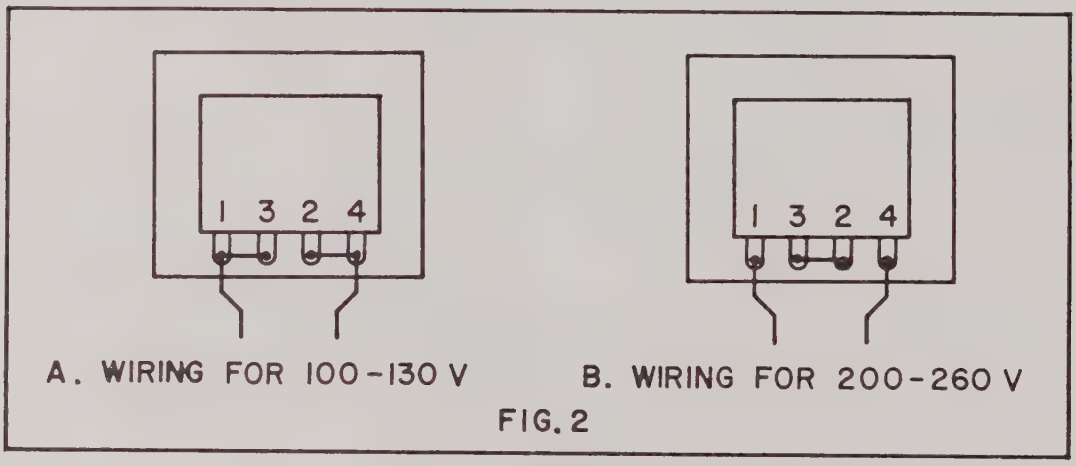


FIG. 2

4. DC. BALANCE CONTROL

The front panel DC BAL control permits adjustment of the internal DC offset of the instrument. It is also possible to balance out DC signals originating externally, within the limits described below. This control permit a swing of ± 2 volts to compensate for changes in the output offset voltage due to:

a. Cutoff FREQ Hz dial position, approximately ± 75mv for complete dial rotation

b. Changes in ambient temperature; temperature coefficient is typically ± 2mv/°C

c. DC drift at constant ambient temperature, ± 0.25mV/hour

d. Switching from low-pass to high pass(or vice versa), approximately ± 75mv

The input is AC-coupled in the high pass mode; the output is DC-coupled in both modes due to the extreme low frequency capability of the instrument. For critical applications where the presence of DC at the output must be maintained at zero or very close to zero volts, the filter should be given a 1/2 hour warmup prior to adjustment of the DC BAL control and a constant ambient temperature must be maintained. In these applications, it is also important that the DC BAL be re-adjusted when the cutoff frequency or mode of operation are changed.

5. HIGH-PASS OR LOW-PASS OPERATION WITH 24db PER OCTAVE ATTENUATION

See figures 3, 4, and 5.

a. Make appropriate power connections as described in paragraph 3.

b. Make appropriate connections to INPUT and OUTPUT connectors.

c. Set mode of operation and cutoff frequency by means of the FREQ. MULT. switch and CUTOFF FREQ. Hz dial.

d. Set power switch to ON.

e. After sufficient warmup, check output DC level, and if necessary, adjust the DC BAL potentiometer(front panel) for zero volts at the output.

f. For normal filter operation, the GROUND switch located on the rear panel should be in the CHASSIS position. If the filter is used in a system where ground loops make ungrounded operation essential, this switch should be in the FLOAT position.

NOTE

In FLOAT operation the signal ground should be connected to the system ground to prevent excessive hum and noise.

g. When filtering consists principally of separating frequency components of an analog signal(frequency domain), the RESPONSE switch located on the rear panel should be in the FLAT position. If the filter is used to separate pulse-type signals from noise(time domain) this switch should be in the T/D position.

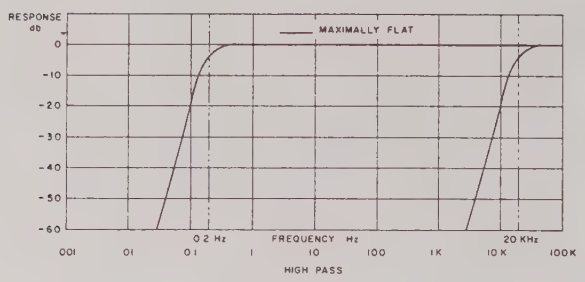


Fig. 3

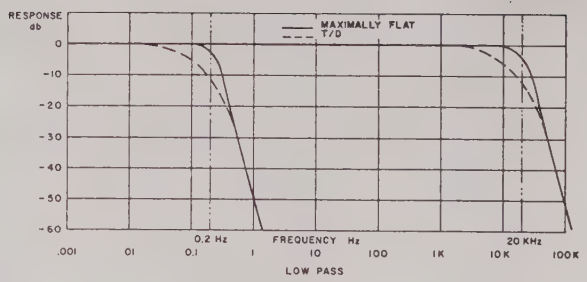


Fig. 4

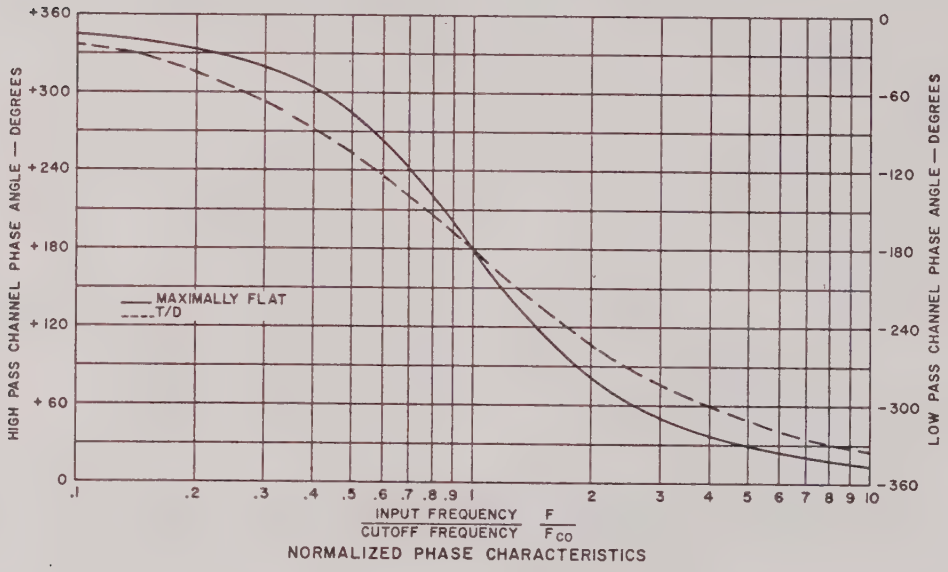


Fig. 5

MODEL AF-220 ONLY

6. HIGH-PASS OR LOW-PASS OPERATION WITH 48db PER OCTAVE ATTENUATION

a. Connect the two channels in series by connecting the output of the left channel to the input of the right channel.

b. Select identical mode of operation and multiplier position for both channels.

c. Set both dials to the same cutoff frequency.

NOTE

When the two channels are in series and set to the same mode of operation with identical cutoff frequencies, the gain at the cutoff frequency will be down 6db from the pass-band gain with the two RESPONSE switches in the FLAT (Butterworth) position, in the T/D position the cutoff frequency will be down approximately 26db.

7. BAND-PASS OPERATION WITH 24db PER OCTAVE ATTENUATION

See figure 6.

a. Connect the two channels in series.

b. Set the left channel to the high-pass mode(this will control the low cutoff frequency).

c. Set the right channel to the low-pass mode(this will control the high cutoff frequency).

NOTE

Band-pass operation can also be obtained by setting the left channel to the low-pass mode and the right channel to the high-pass mode.

d. The minimum pass-band is obtained by setting the high cutoff frequency equal to the low cutoff frequency. In this condition, the insertion loss is 6db, and the -3db cutoff frequencies occur at 0.8 and 1.25 times the mid-band frequency.

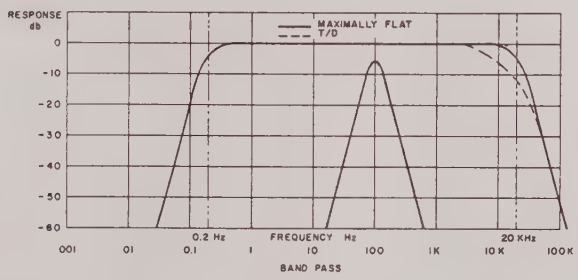


Fig. 6

8. BAND REJECT OR NOTCH FILTER OPERATION

See figure 7.

a. Connect the two channels in parallel by connecting the input signal to the BNC INPUT connector of both channels simultaneously. The output from both channels should be added through two equal external resistors in series with each output. The junction of the resistors is the output of the filter. It is recommended that the resistors be approximately 1,000 Ohms and of the carbon or metal film type. If the two resistors are not equal, the gain on one side of the notch will be different from that on the other. The smaller the summing resistances, the greater the flat loss will be through the filter in the pass-band region, due to the combined effects of the 50 Ohm output impedance, and the summing resistances.

b. The first channel should be set for low-pass operation.

c. The second channel should be set for high-pass operation.

NOTE

The output impedance in the band-reject mode will be approximately 50 ohms plus one half the resistance of one summing resistor. The maximum input should not exceed 3 volts rms and the maximum open circuit output voltage in this mode will be 1.5 volts rms.

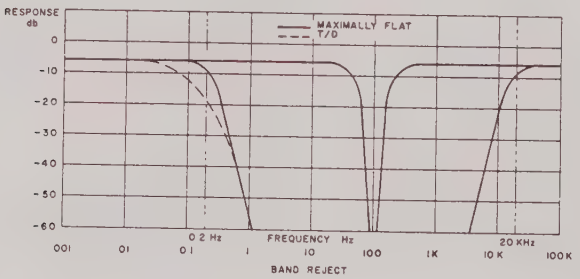


Fig. 7

ELECTRICAL PARTS LIST, MODELS AF-210 & AF-220

Ref. Desig.	Mfr.	Part/DWG No.	Description
R101			Resistor, composition, 3K ohms ± 5%, 1/2 watt
R102			Not Used
R103			Resistor, composition, 6.2 ohms ± 5%, 1/2 watt
R104			Resistor, composition, 68K ohms ± 10%, 1/2 watt
R105	Corning Glass	NA 60	Resistor, metal film, 1.2K ohms ± 1%, 1/4 watt
R106			Resistor, composition, 39K ohms ± 10%, 1/2 watt
R107	Corning Glass	NA 60	Resistor, metal film, 27.4K ohms ± 1%, 1/4 watt
R108	Corning Glass	NA 60	Resistor, metal film, 20K ohms ± 1%, 1/4 watt
R109			Resistor, composition, 3K ohms ± 5%, 1/2 watt
R110			Not Used
R111			Resistor, composition, 6.2 ohms ± 5%, 1/2 watt
R112			Resistor, composition, 5.1K ohms ± 10%, 1/2 watt
R113			Resistor, composition, 150K ohms ± 10%, 1/2 watt
R114			Resistor, composition, 68K ohms ± 10%, 1/2 watt
R115, R116	Corning Glass	NA 60	Resistor, metal film, 10K ohms ± 1%, 1/4 watt
R117, R118	Ward Leonard	3 X	Resistor, wire wound, 500 ohms ± 5%, 3 watts
R201			Resistor, composition, 2.2 megohms ± 5%, 1/2 watt

Ref. Desig.	Mfr.	Part/DWG No.	Description
R202			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R203			Resistor, composition, 2.2 megohms ± 5%, 1/2 watt
R204			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R205			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R206			Resistor, composition, 100 ohms ± 10%, 1/2 watt
R207			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R208			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R209			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R210			Resistor, composition, 100 ohms ± 10%, 1/2 watt
R211			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R212			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R213			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R214			Resistor, composition, 100 ohms ± 10%, 1/2 watt
R215			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R216			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R217			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R218			Resistor, composition, 100 ohms ± 10%, 1/2 watt

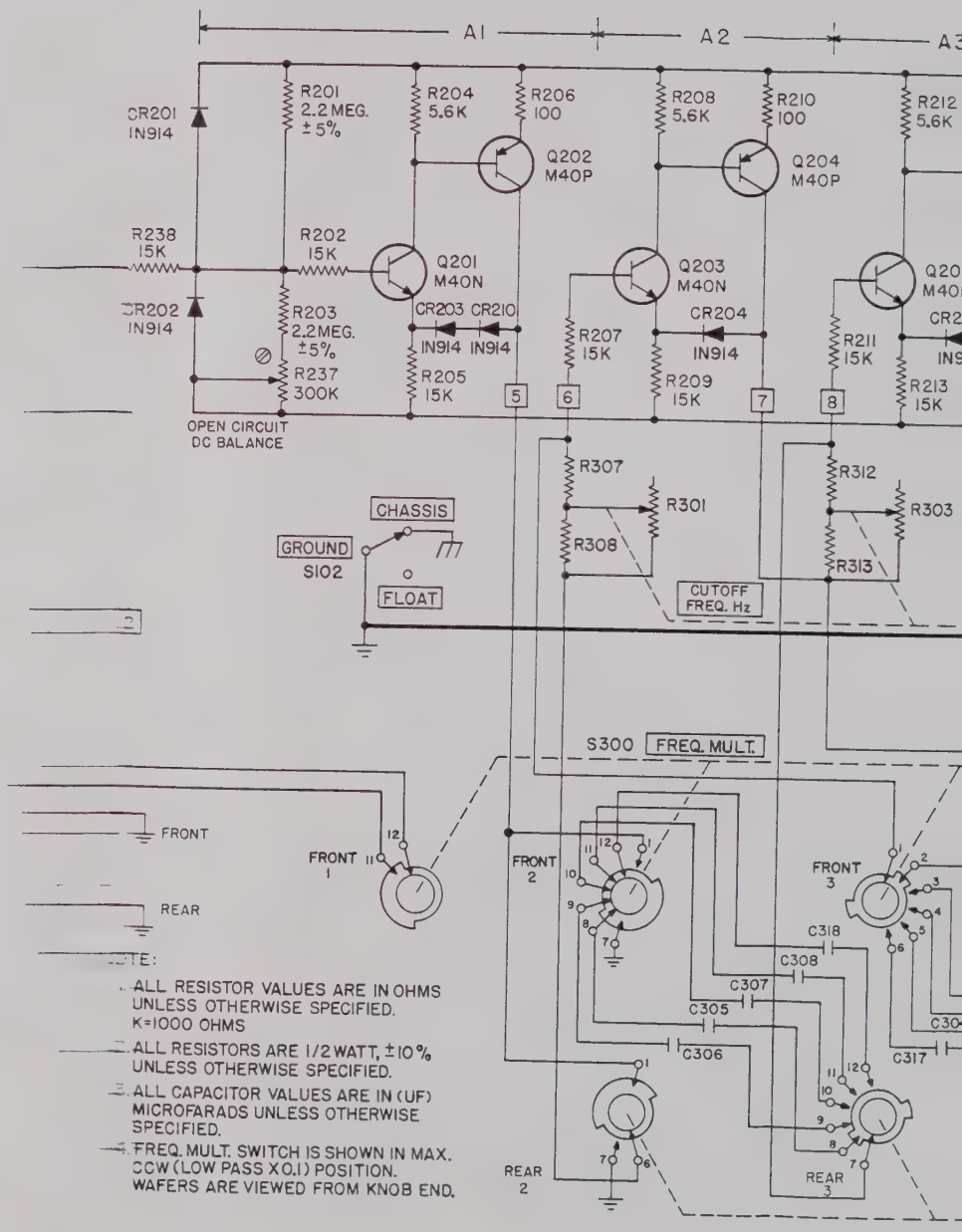
Ref. Desig.	Mfr.	Part/DWG No.	Description
R219			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R220			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R221			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R222			Resistor, composition, 100 ohms ± 10%, 1/2 watt
R223			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R224			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R225			Resistor, composition, 22K ohms ± 5%, 1/2 watt
R226			Resistor, composition, 100 ohms ± 10%, 1/2 watt
R227			Resistor, composition, 10K ohms ± 5%, 1/2 watt
R228			Resistor, composition, 2.2K ohms ± 10%, 1/2 watt
R229			Resistor, composition, 47 ohms ± 10%, 1/2 watt
R230, R231			Resistor, composition, 10 ohms ± 10%, 1/2 watt
R232			Resistor, composition, 47 ohms ± 10%, 1/2 watt
R233	Ward Leonard	2X	Resistor, wire wound, 51 ohms ± 5%, 2 watt
R234			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R235, R236			Resistor, composition, 3K ohms ± 5%, 1/2 watt
R237	CTS	U201	Resistor, variable, 300K ohms ± 30%, 1/4 watt

Ref. Desig.	Mfr.	Part/DWG No.	Description
R238			Resistor, composition, 15K ohms ± 10%, 1/2 watt
R239			Resistor, composition, 5.6K ohms ± 10%, 1/2 watt
R240			Resistor, composition, 100K ohms ± 10%, 1/2 watt
R241	Newport Instrument	8 PC	Resistor, variable, 5K ohms ± 10%
R242	CTS	U201	Resistor, variable, 1K ohms ± 30%, 1/4 watt
R244			Resistor, composition, 1K ohms ± 5%, 1/4 watt
R301	Multimetrics	100-B-1001-4	Resistor, variable, frequency determining
R302	Multimetrics	100-B-1001-6	Resistor, variable, frequency determining
R303	Multimetrics	100-B-1001-3	Resistor, variable, frequency determining
R304	Multimetrics	100-B-1001-5	Resistor, variable, frequency determining
R305			Not Used
R306			Not Used
R307, R308			Resistor, trim
R309	CTS	U201	Resistor, variable, 5K ohms ± 30%, 1/4 watt
R310 thru R313			Resistor, trim
R314	CTS	U201	Resistor, variable, 2K ohms ± 30%, 1/4 watt
R315, R316			Resistor, trim
C101, C102	Sprague	34D607G030GL2	Capacitor, electrolytic, 600 uf, 30 volts

Ref. Desig.	Mfr.	Part/DWG No.	Description
C103			Not Used
C104	Sprague	192P-10492	Capacitor, mylar, .1 uf, 200 volts DC
C105	Multimetrics	CEX-51-25	Capacitor, electrolytic, 51 uf, 25 volts
C106	Sprague	5GA-T20	Capacitor, ceramic disc, 200 pF ± 20%
C107	Multimetrics	CEX-51-25	Capacitor, electrolytic, 51 uf, 25 volts
C108			Not Used
C109	Sprague	5GA-T20	Capacitor, ceramic disc, 200 pf ± 20%
C110, C111	Multimetrics	CEX-51-25	Capacitor, electrolytic, 51 uf, 25 volts
C201	Multimetrics	100-B-1002-9	Capacitor, mylar, 3 uf, ± 10%, 100 volts
C202	Sprague	192P-10492	Capacitor, mylar, .1 uf, 200 volts DC
C203	Sprague	5GA-T10	Capacitor, ceramic disc, 100 pf ± 10%
C301	Multimetrics	100-B-1002-8	Capacitor, mylar, 10 uf
C302	Multimetrics	100-B-1002-4	Capacitor, mylar, 1 uf
C303	Multimetrics	100-B-1002-5	Capacitor, mylar, .1 uf
C304	Multimetrics	100-B-1002-7	Capacitor, mylar, .01 uf
C305	Multimetrics	100-B-1002-8	Capacitor, mylar, 10 uf
C306	Multimetrics	100-B-1002-4	Capacitor, mylar, 1 uf
C307	Multimetrics	100-B-1002-5	Capacitor, mylar, .1 uf
C308	Multimetrics	100-B-1002-7	Capacitor, mylar, .01 uf
C309	Multimetrics	100-B-1002-8	Capacitor, mylar, 10 uf
C310	Multimetrics	100-B-1002-4	Capacitor, mylar, 1 uf
C311	Multimetrics	100-B-1002-5	Capacitor, mylar, .1 uf
C312	Multimetrics	100-B-1002-7	Capacitor, mylar, .01 uf

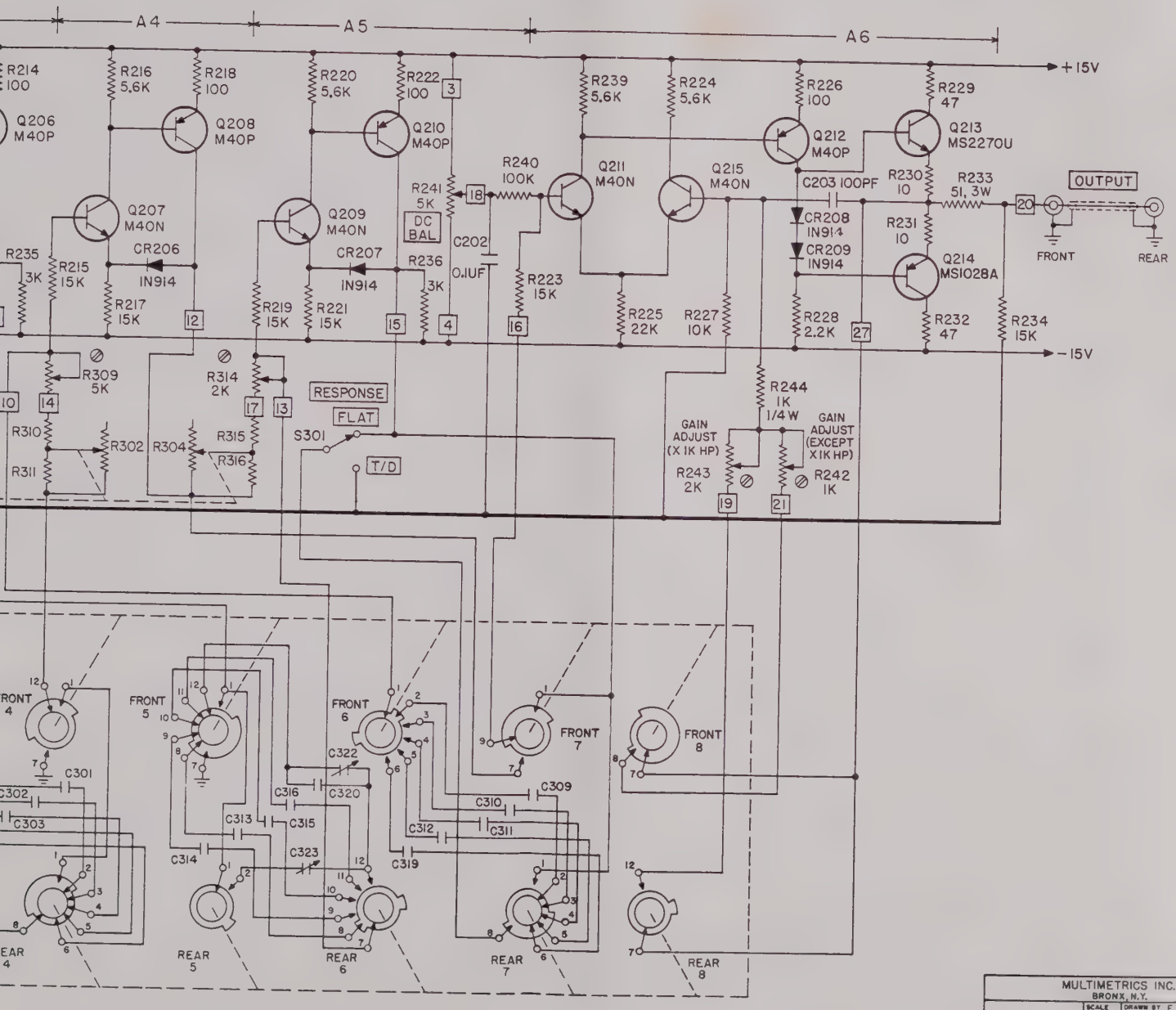
Ref. Desig.	Mfr.	Part/DWG No.	Description
C313	Multimetrics	100-B-1002-8	Capacitor, mylar, 10 uf
C314	Multimetrics	100-B-1002-4	Capacitor, mylar, 1 uf
C315	Multimetrics	100-B-1002-5	Capacitor, mylar, .1 uf
C316	Multimetrics	100-B-1002-7	Capacitor, mylar, .01 uf
C317 thru C319	Arco-Elmenco	CM20E102F	Capacitor, silver mica, 1000 pf ± 1%
C320	Arco-Elmenco	CM20D821D	Capacitor, silver mica, 820 pf ± 2%
C321			Not Used
C322, C323	Arco-Elmenco	406	Capacitor, variable, 15 - 115 pf
CR101 thru CR104	Multimetrics	GI 44	Diode, rectifier
CR105	Multimetrics	TS823H2	Diode, zener, 6 volts
CR106, CR107	Multimetrics	AC-359Z	Diode, zener, 5 volts
CR201 thru CR210		1N914	Diode, silicon
Q101	Multimetrics	MS1028A	Transistor, PNP silicon
Q102 thru Q105	Multimetrics	M40N	Transistor, NPN silicon
Q106	Multimetrics	MS2270U	Transistor, NPN silicon
Q107 thru Q110	Multimetrics	M40P	Transistor, PNP silicon
Q201	Multimetrics	M40N	Transistor, NPN silicon
Q202	Multimetrics	M40P	Transistor, PNP silicon
Q203	Multimetrics	M40N	Transistor, NPN silicon
Q204	Multimetrics	M40P	Transistor, PNP silicon
Q205	Multimetrics	M40N	Transistor, NPN silicon
Q206	Multimetrics	M40P	Transistor, PNP silicon
Q207	Multimetrics	M40N	Transistor, NPN silicon

Ref. Desig.	Mfr.	Part/DWG No.	Description
Q208	Multimetrics	M40P	Transistor, PNP silicon
Q209	Multimetrics	M40N	Transistor, NPN silicon
Q210	Multimetrics	M40P	Transistor, PNP silicon
Q211	Multimetrics	M40N	Transistor, NPN silicon
Q212	Multimetrics	M40P	Transistor, PNP silicon
Q213	Multimetrics	MS2270U	Transistor, NPN silicon
Q214	Multimetrics	MS1028A	Transistor, PNP silicon
Q215	Multimetrics	M40N	Transistor, NPN silicon
S101	Cutler-Hammer	7501K13	Switch, toggle, SPST
S102	Switchcraft	46202L	Switch, slide, SPST
S301	Switchcraft	46203L	Switch; slide, SPDT
S300	Multimetrics	200-D-1001	Switch, rotary
T101	Multimetrics	200-C-1002	Transformer, power
F101			Fuse Slo Blow 1/16 amp (230v - AF - 210)
			Fuse Slo Blow 1/8 amp (115v-AF-210 & 230v-AF-220)
			Fuse Slo Blow 1/4 amp (115v-AF-220)

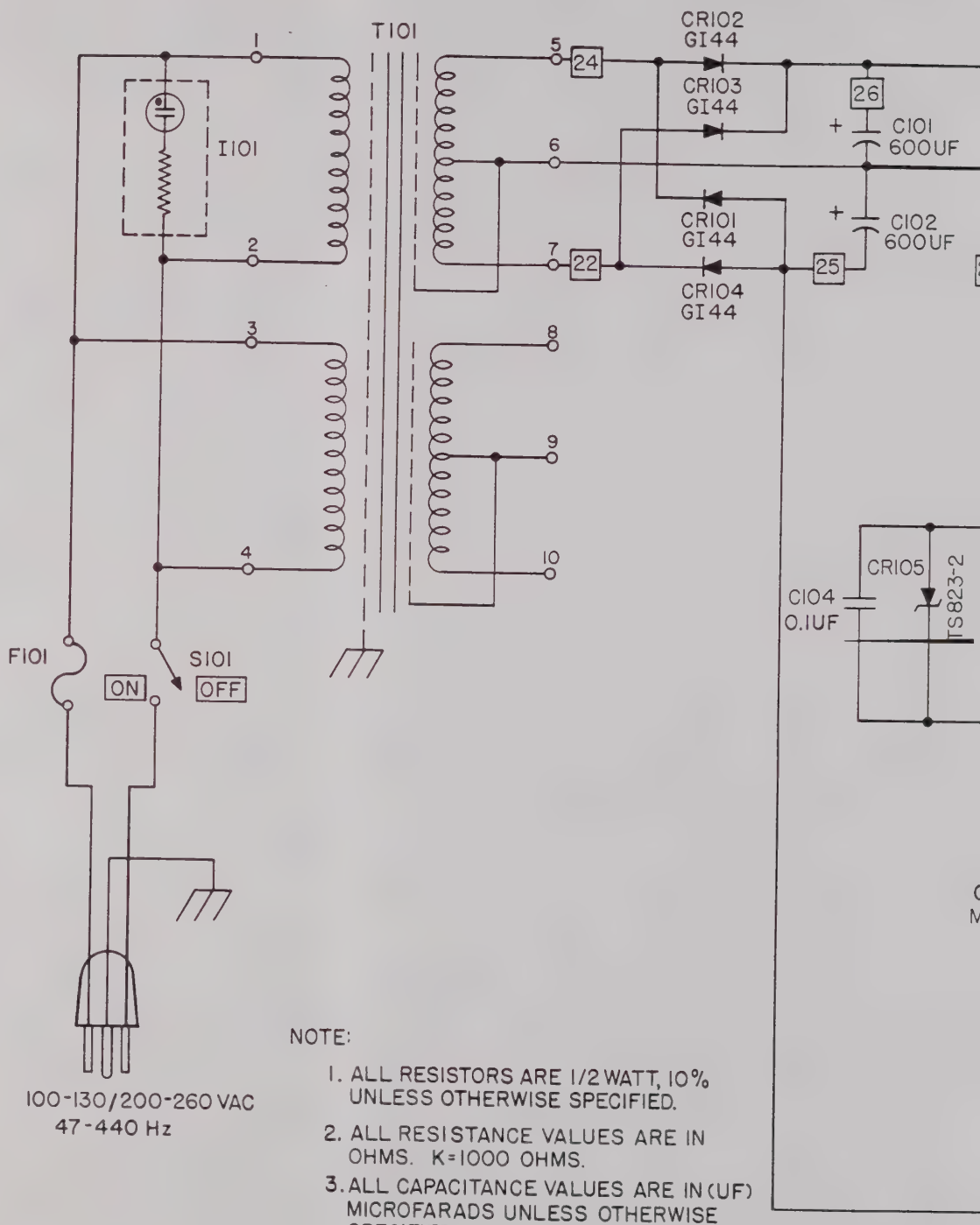


NOTE:

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED. K=1000 OHMS
2. ALL RESISTORS ARE 1/2 WATT, ±10% UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITOR VALUES ARE IN (UF) MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. FREQ. MULT. SWITCH IS SHOWN IN MAX. CCW (LOW PASS X0.1) POSITION. WAFERS ARE VIEWED FROM KNOB END.

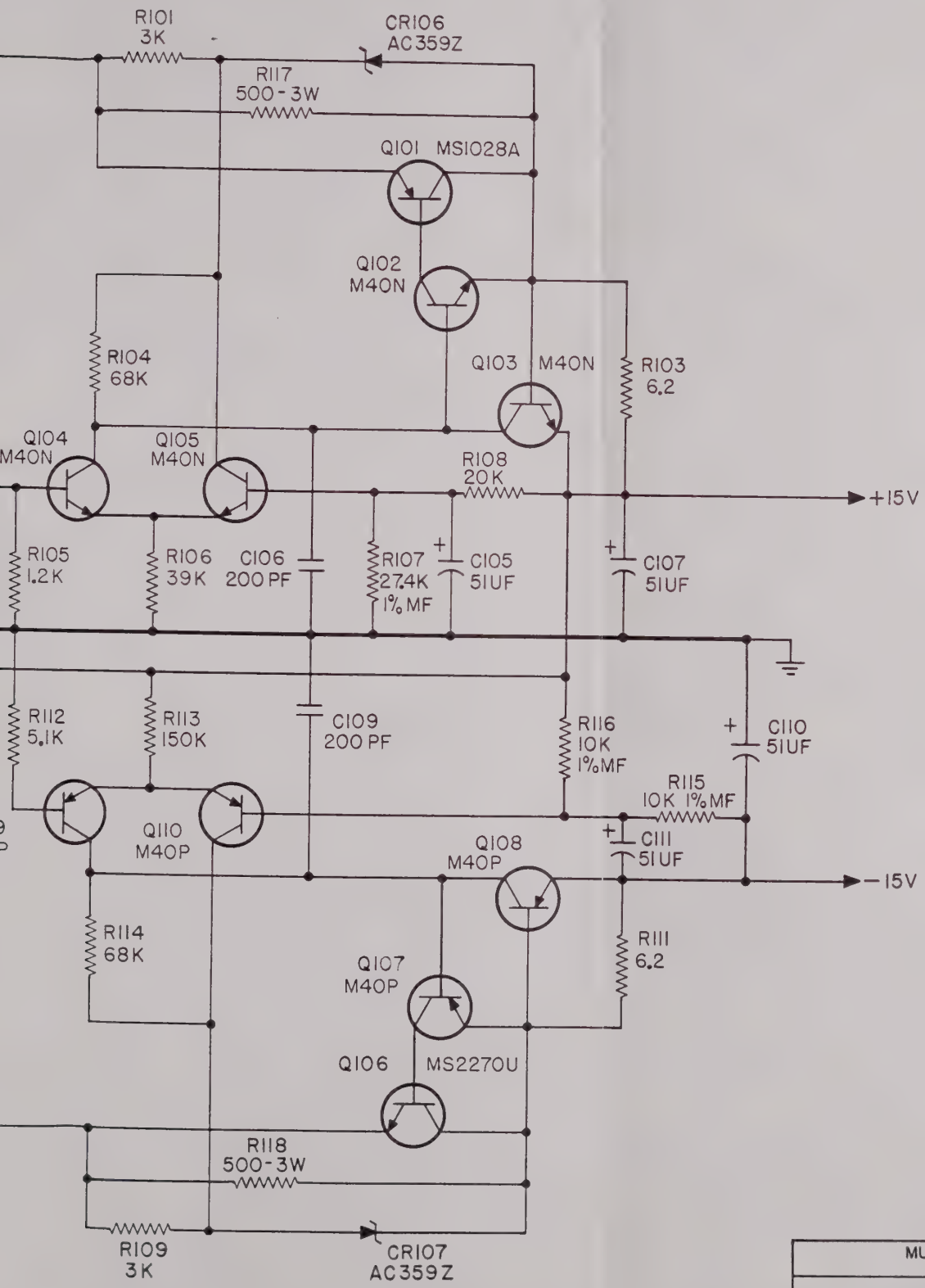


MULTIMETRICS INC. BRONX, N.Y.		
	SCALE —	DRAWN BY F
		APPROVED BY
TITLE	SCHEMATIC DIAGRAM SERIES AF-200	
DATE 3 DEC 68	DRAWING NUMBER 200-D-000	

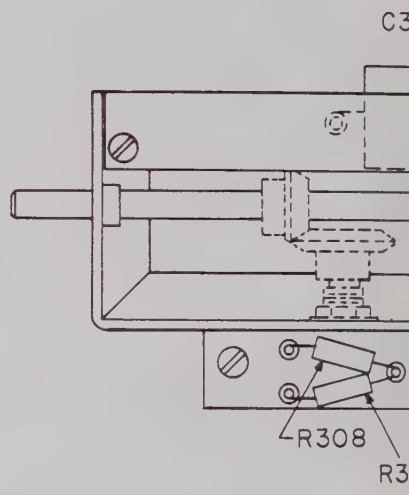


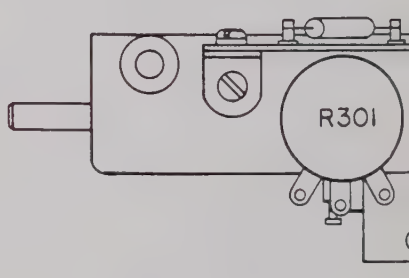
NOTE:

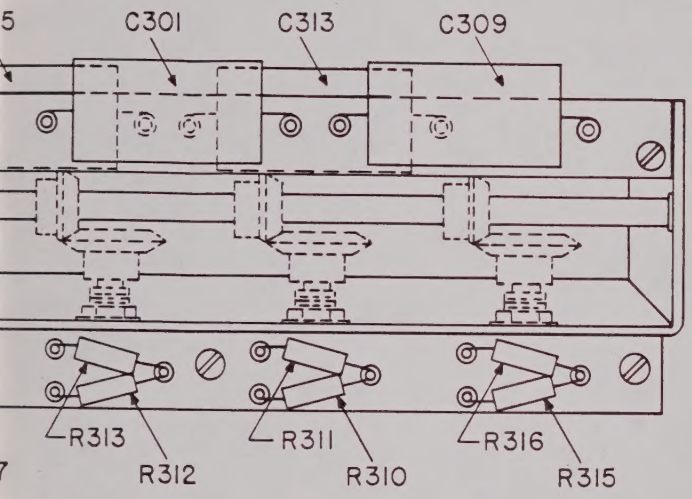
1. ALL RESISTORS ARE 1/2 WATT, 10% UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTANCE VALUES ARE IN OHMS. K=1000 OHMS.
3. ALL CAPACITANCE VALUES ARE IN (UF) MICROFARADS UNLESS OTHERWISE SPECIFIED.

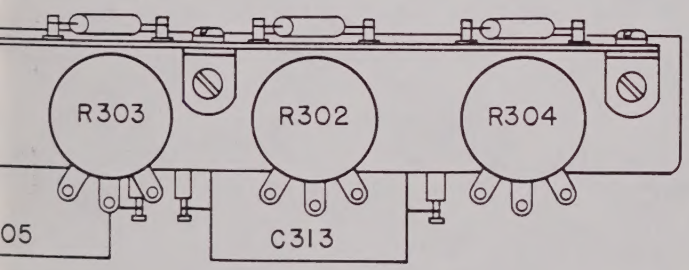


MULTIMETRICS INC. BRONX, N.Y.		
	SCALE	DRAWN BY F.F.
		APPROVED BY K.S.
TITLE	SCHEMATIC DIAGRAM PWR. SUPP. SERIES AF-200	
DATE	DRAWING NUMBER 200-D-0002	

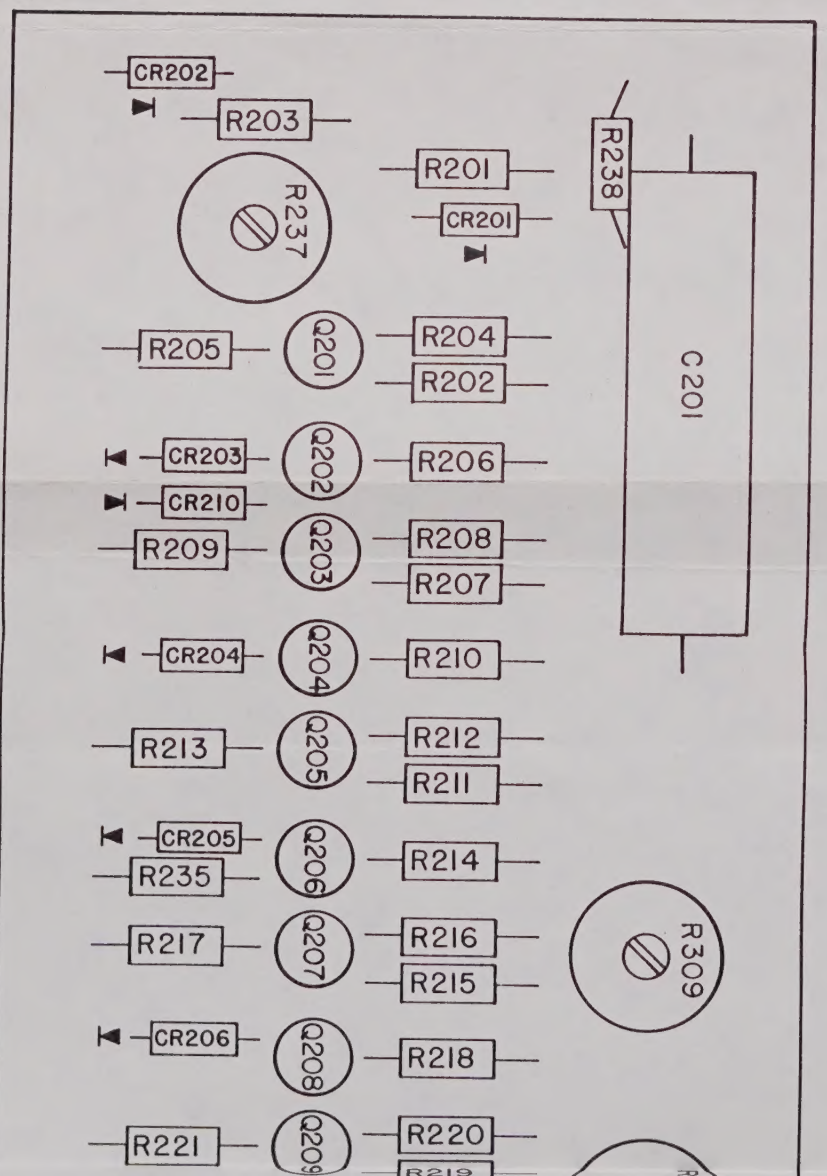

C3
R308
R3


R301





MULTIMETRICS INC. BRONX, N.Y.		
	SCALE —	DRAWN BY F. F. APPROVED BY K. S.
TITLE COMPONENTS LOCATION GEAR TRAIN BRACKET		
DATE 4 DEC 68	DRAWING NUMBER 200-C-0004	


CR202
R203
R237
R201
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R238
C201
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R212
R211
CR205
Q206
R214
R235
R217
Q207
R216
R215
R309
CR206
Q208
R218
R221
R220

MULTIMETRICS, INC. BRONX N.Y.		
	SCALE —	DRAWN BY F. F APPROVED BY K. S
TITLE	COMPONENTS LOCATION PRINTED CIRCUIT BOARD	
DATE 4 DEC 68	DRAWING NUMBER 200-D-0003	

MP MASTER
MA25165